TAXONOMY OF THE *VICIA LUDOVICIANA* COMPLEX (LEGUMINOSAE)[1]

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ABSTRACT

The annual vetches *Vicia ludoviciana* Nutt. ex T. & G., *V. leavenworthii* T. & G., *V. exigua* Nutt. ex T. & G., and their varieties compose the native North American *V. ludoviciana* complex. The center of diversity is Texas; distribution is from Alabama to California, and from northern Mexico into the Rocky Mountains of Colorado. Karyotypes, artificial hybridizations, characteristics of the breeding system, and various morphological data are used with previously reported edaphic relationships and seed morphology to establish relationships reported herein. This taxonomic treatment reduces the taxa of the complex to 1 wide-ranging and variable species, consisting of 1 subspecies containing 5 geographical races, and a second subspecies containing 2 races.

Key Words: *Vicia*, North America, taxonomy, chromosomes, breeding system

INTRODUCTION

The *Vicia ludoviciana* complex (Leguminosae) is a group of annual vetches native to North America. The complex includes *Vicia ludoviciana* Nutt. ex T. & G., *V. leavenworthii* T. & G., *V. exigua* Nutt. ex T. & G., and varieties of each. Lassetter (1975) has shown that *Vicia hassei* Wats. (*V. exigua* var. *hassei*) is not part of this complex. Taxa of the complex are found from Alabama to California and from northern Mexico into the Rocky Mountains of Colorado. The center of diversity is Texas where the greatest number of taxa occur and where intergradation between taxa is greatest.

The taxonomic relationships within the complex have been problematic, and conclusions of different authors have not agreed. Previous workers relied almost solely on field and herbarium data.

Shinners (1948) recognized *Vicia ludoviciana* (varieties *typica, texana, laxiflora*) and *V. leavenworthii* (varieties *typica, occidentalis*) in Texas. Species were separated by peduncle length, and varieties by overall size as well as flower characters. According to Shinners, the distribution of taxa is at least partly associated with soil texture. He stated that overlaps and intergradation between

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taxa exist. Shinners did not consider the western *V. exigua* as occurring in Texas.

Turner (1959) also recognized two species in Texas, but distinguished them on the basis of flower number. Varieties were separated by leaflet characters and by length of flowering axes. Like Shinners, Turner believed that distribution was related in part to soils, and stated that intergradation exists between varieties of each species, and between the species. Turner considered *Vicia ludoviciana* var. *texana* to be *V. leavenworthii* var. *occidentalis*.

In addition to *Vicia ludoviciana* and *V. leavenworthii,* Hermann (1960) also believed *V. exigua* extended into Texas and was in fact *V. leavenworthii* var. *occidentalis* sensu Shinners and Turner. These three species were separated by Hermann on the basis of number of flowers per peduncle, peduncle length, and flower character.

Isely (personal communication) believed that only two species exist although this scheme was not formally proposed. He viewed *Vicia exigua* (as did Hermann, 1960) to encompass *V. leavenworthii* var. *occidentalis* sensu Shinners. Isely believed all the other taxa were best recognized as one of two varieties of *V. ludoviciana.*

Because the total range of the complex is widespread, the constituent taxa have been included in several state and local floras. Correll and Johnston (1970) is the only treatment that covers a geographical area from which all three species have been reported. The treatment of *Vicia* by these authors is largely adapted from Hermann (1960), and their view of the *V. ludoviciana* complex differs only in minor details of ranges and descriptions.

The traditional taxon names of Shinners are predominately used throughout this paper so that the reader can better relate to the taxa being discussed. Name changes and shifts in taxon concepts are largely reserved for the taxonomic treatment.

MATERIALS AND METHODS

Chromosome study included meiotic counts determined from anther squashes and karyotype analyses from mitotic root material. Field-collected buds were fixed in Newcomer's (1953) fixative. Buds and root tips from greenhouse plants were fixed in acetic-alcohol (absolute ethanol: glacial acetic acid—3:1). Anther material was stained with propiocarmine. Root tips were pretreated for 4 hours at 13–14° C in 0.002 M 8-hydroxyquinoline and were stained with Schiff's reagent according to the Feulgen method. Slides were made permanent by the method of Bowen (1956). Meiotic figures and karyotypes were drawn with a Zeiss camera lucida and a Leitz drawing apparatus, respectively. Voucher specimens are deposited in the Iowa State University Herbarium (ISC).

Reciprocal artificial hybridizations were attempted between the three traditional species. It was necessary to emasculate the self-fertile flowers because pollen is often released in the bud stage. A total of 216 crosses was made. An additional 15 emasculations with no pollen transfers were performed as a check for apomixis. Observations were made on the breeding system.

One hundred six mass collections of about 1,200 total specimens were made. Fifty-five morphological characters were observed and recorded. The characters observed included those used by previous workers that I also believed useful, as well as some additional ones. For brevity, the entire list and explanation is omitted here, but is available from Lassetter (1972).

Herbarium studies were conducted by utilizing material from the following herbaria: ARIZ, ASC, BRY, CAS, COLO*, DS, F*, FSU, GH, ISC, LA, LAF, LSU, MEXU*, MICH*, MIN, MISS, MISSA, MO, NLU, NMC, NO, NY, OKL, OKLA, ORE, PH*, POM*, RSA, SBBG, SMB, SD, SMS, SMU, TENN, TEX, TTC, UARK, UC, UM, UNM, US, VDB, and University of Southern Mississippi (herbarium designations follow Holmgren and Keuken (1974); asterisks indicate selected material only).

Lassetter (1978a) discussed the taxonomic significance of the following seed characters: diameter, relative hilum length (hilum length ÷ seed circumference × 100), hilum length, hilum width at wide end, hilum width at narrow (lens) end, base color of testa, and color of mottling. Identification of taxa by seed characters alone was shown to be unreliable due to overlapping variation.

Lassetter (1978b) reported on edaphic relationships and demonstrated that some taxa are rather plastic and regularly occur in soils of various texture. Other taxa were only found on sandy or sandy loam soils.

RESULTS AND DISCUSSION

Cytological data

The genus *Vicia* has chromosome base numbers of $x = 5$, $x = 6$, and $x = 7$ (Senn, 1938; Darlington and Wylie, 1955; Fedorov, 1969). Workers presume that the lower numbers are derived from an ancestral $n = 7$ (Stebbins, 1958; Rousi, 1961).

During the present study, more than 40 meiotic counts were made, several for each taxon from various locations throughout the range of the complex. All counts for all taxa were $n = 7_{II}$ (Figure 1 comprises a sample); meiosis appeared normal, as previously observed by Turner (1956).

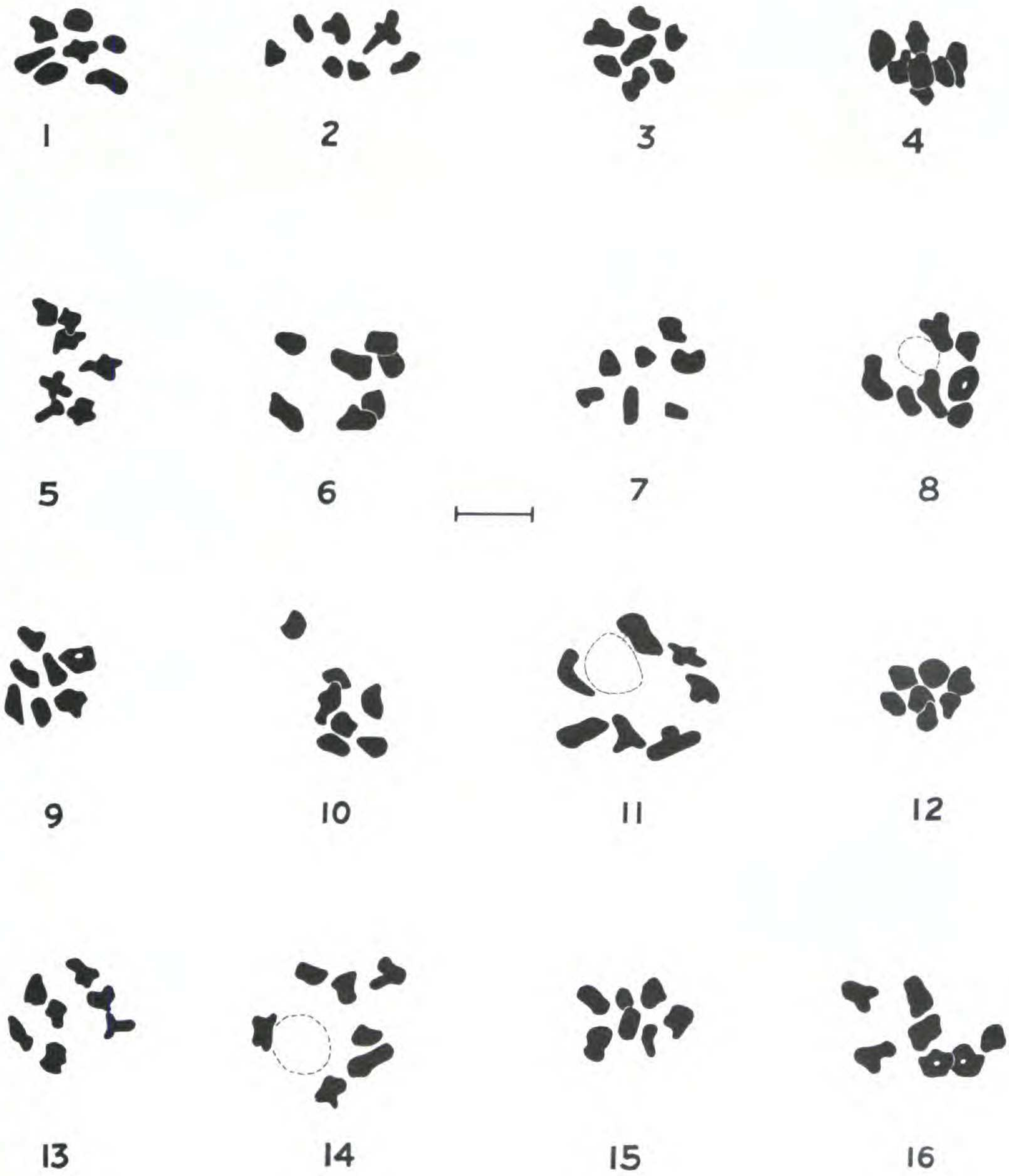
Previous to this study only three chromosome counts were reported in the literature. Turner (1956) reported three determinations of $n = 7$ for *Vicia ludoviciana* var. *typica* and one determination of $2n = 14$ for *V. leavenworthii* var. *typica.* Turner also listed an unpublished count of $n = 7$ by Johnston for *V. leavenworthii* var. *occidentalis.*

Figure 1. Meiotic chromosomes of *Vicia.* Line scale = 10 microns

1. *V. ludoviciana* var. *typica* (race 1). Voucher grown from seed from S. McDaniel 8881, Dauphin Island, Alabama, (FSU #124825).
2. *V. ludoviciana* var. *typica* (race 1). Lassetter 1760, Walker Co., Texas.
3. *V. ludoviciana* var. *laxiflora* (race 5). Lassetter 1721, Val Verde Co., Texas.
4. *V. ludoviciana* var. *laxiflora* (race 5). Lassetter 1851, Llano Co., Texas.
5. *V. ludoviciana* var. *texana* (race 2). Lassetter 1773, Aransas Co., Texas.
6. *V. leavenworthii* var. *typica* (race 6). Lassetter 1832, Hill Co., Texas.
7. *V. leavenworthii* var. *typica* (race 6). Lassetter 1847, Concho Co., Texas.
8. *V. leavenworthii* var. *occidentalis* (race 4). Lassetter 1731, Culberson Co., Texas.
9. *V. leavenworthii* var. *occidentalis* (race 4). Voucher grown from seed from D. Keil 1162, Maricopa Co., Arizona (ARIZ #38829).
10. *V. exigua* var. *exigua* (race 3). Voucher grown from seed collected by I. Marin, Riverside Co., California.
11. *V. exigua* var. *exigua* (race 3). Voucher grown from seed from D. H. Hoover s.n. San Diego Co., California, (CAS #514387).
12. *V. ludoviciana* var. *texana* (race 2). Lassetter 1779, Willacy Co., Texas.
13. *V. ludoviciana* var. *texana* (race 2). Lassetter 1783, Jim Wells Co., Texas.
14. *V. ludoviciana* var. *laxiflora* (race 5). Voucher grown from seed from M. Fechu and F. Martizen 160, Chihuahua, Mexico (TEX s.n.).
15. *V. exigua* var. *exigua* (race 3). Voucher grown from seed from R. N. Philbrick B65-1399 and M. Benedict, Santa Cruz Island, California (SBBG #29483).
16. *V. leavenworthii* var. *occidentalis* (race 4). Lassetter 1726, Brewster Co., Texas.

Most karyotyping of *Vicia* species has been done with those native to the Old World, for which much literature exists. Sveshnikova (1927) investigated 27 Old World species and found that almost every species had a different karyotype.

Shrivastava (1963) studied eight Old World species and found eight different karyotypes. Mettin and Hanelt (1968) studied 11 Old World and one South American species and concluded that most taxa in *Vicia* are characterized by different karyotypes, that chromosome sizes also are somewhat different, and that these differences seem to apply to both Old and New World species.



Stankevicz (1970) studied morphological, karyological, and ecological-geographical characteristics of 53 Russian species of *Vicia.*

Very little karyotype work has been done with New World species. Turner (1956) illustrated $2n = 14$ chromosomes of *V. leavenworthii* var. *typica,* but the drawing does not show the satellited chromosomes that are present. It was presumably made for a count only and was not a karyotype preparation.

Lassetter (1975) utilized karyotypes and other data in a taxonomic treatment separating *Vicia hassei* from *V. exigua,* and Lassetter and Gunn (1979) used karyotypes in establishing relationships between *V. menziesii, V. nigricans,* and *V. gigantea.*

Veerasethakul and Lassetter (1981) presented a preliminary survey of native New World *Vicia* karyotypes and reviewed previous work with New World species.

Taxa of the *V. ludoviciana* complex all have the same basic karyotype (Veerasethakul and Lassetter, 1981). I believe pairs one, two, five, and seven (numbered from left to right) are the same in all karyotypes. Some minor variation in these pairs was observed in different preparations from the same taxon, and sometimes small variation from cell to cell in one preparation was observed. These differences are, I believe, due to slight inconsistencies in length and/or temperature of pretreatment, and to differences in the precise time of mitosis at which cells were fixed.

The differences in the other three pairs of chromosomes are believed to represent inherent karyological differences between taxa and are given in Table 1.

With regard to evolution of karyotypes, Levitskly (1931) formalized the concept of symmetrical karyotypes (chromosomes all metacentric or submetacentric and nearly equal in size) as contrasted to asymmetrical karyotypes, and he proposed a trend of increasing karyotype asymmetry in angiosperms.

According to Stebbins (1950), perennial vetches with $n = 7$ have mostly symmetrical karyotypes, while karyotypes of annuals with a reduced and derived $n = 6$ or $n = 5$ are highly asymmetrical.

Taxa in this complex are annuals with asymmetrical karyotypes which are $n = 7$ and presumably have achieved asymmetry without a reduction in chromosome numbers. Stebbins (1958, 1971) stated that karyotypes of species or taxa of lesser rank (all with the same chromosome number) that differ in size and form of individual

Table 1. Variation in three chromosome pairs within the *Vicia ludoviciana* complex.

Taxon	Pair three	Pair four	Pair six
V. ludoviciana var. *typica*	telocentric	sub-metacentric	telocentric
V. ludoviciana var. *laxiflora*	telocentric	sub-metacentric	sub-metacentric
V. ludoviciana var. *texana*	sub-telocentric	sub-metacentric	telocentric
Race 7 (has no traditional taxon name)	telocentric	sub-telocentric	telocentric
V. leavenworthii var. *typica*	telocentric	sub-telocentric	telocentric
V. leavenworthii var. *occidentalis*	telocentric	sub-telocentric	telocentric
V. exigua var. *exigua*	telocentric	sub-telocentric	sub-metacentric

chromosomes are best explained by an assumption of increasing asymmetry. In a group of taxa undergoing such a process, the most symmetrical karyotypes would be the most primitive, and vice versa.

From Table 1 and Veerasethakul and Lassetter (1981), the karyotype of *Vicia ludoviciana* var. *laxiflora* is the most symmetrical in the complex. The most asymmetrical karyotype is the one common to *V. leavenworthii* var. *typica*, *V. leavenworthii* var. *occidentalis*, and race 7 of this taxonomic treatment (this race has never received formal recognition and therefore has no traditional taxon name). These three taxa, however, are morphologically dissimilar. A similar situation was reported by Rousi (1961) who found small karyotype differences in different strains of *V. tenuifolia*.

Most attempts at hybridization of *Vicia* taxa have not been successful, and this lack of success has been attributed to karyotype differences. Most workers have been unsuccessful even in crossing different strains of a single species (Sveshnikova, 1927). Plitmann (1967) also stated that most workers have been unsuccessful in crossing different taxa of *Vicia*. Of the crosses evaluated by Plitmann (1967), most involved cultivated species of Eurasian origin, and most were intraspecific crosses between subspecific taxa. Gunn (pers. comm.) even rejected all reputed "successful hybridizations" in the literature and stated that the only successful ones have been between some varieties of "*Cracca*" species, and between *V. sativa* and *V. angustifolia.* These two closely related taxa are highly influenced cultivars and were shown by Sveshnikova (1927) and Hollings and Stace (1974) to have similar karyotypes. They have been considered as a single species by Ball (1968), Gunn (1970, 1979), and others.

Artificial hybridization

Reciprocal intraspecific crosses involving *Vicia ludoviciana* and *V. leavenworthii* were successful and produced fully viable F_2 plants, but those involving *V. exigua* were not successful. Dormancy in *V. exigua* seed is difficult to break. Seeds from crosses involving *V. exigua* were treated with 0.1 M thiourea (Ballard and Buchwald, 1971), which forced radicles to emerge, but no seedlings resulted. The same difficulty existed in germinating field-collected *V. exigua* seeds for cytological work. I believe the lack of F_1 *V. exigua* plants was largely because of faulty germination technique and not to inviability of the hybrid seed.

Reciprocal interspecific crosses were mostly unsuccessful; most seeds were shriveled, and seedlings were abnormal, with weak radicles and kinked, stunted epicotyls. In cross 1 (Table 2), fruits appeared normal but contained only shriveled, inviable seeds. No F_1 plants resulted from cross 1, 3, 4, or 6. One F_1 plant resulted from cross 2. The plant was very slow-growing, small, and stunted. It eventually flowered, and several young fruits were produced, but they quickly withered, and no seeds were set. Pollen from this plant was 51 percent sterile. Cross 5 (Table 2) produced a progeny of four F_1 plants. All were weak and lacked normal vigor. One plant grew for two weeks, became chlorotic, and died. The other three flowered, but produced no fruits or seed. Anthers were minute (ca. 0.15 mm) and did not dehisce. Almost no pollen grains stained with cotton blue in lactophenol, and most were spherical or elliptical as compared with the normal elongate appearance of mature grains. Evidently, the anthers and pollen ceased development before either matured. None of the five F_1 plants, therefore, produced any seed.

Anther squashes of the F_1 plants from cross 2 and cross 5 (Table 2) were not successful, and meiosis was not observed. Removal of

Table 2. Results of interspecific artificial hybridizations within the *Vicia ludoviciana* complex.

Taxa of cross	Number of crosses attempted	Number of crosses producing seed	Number of F_1 plants
1. V. ludoviciana var. *typica* × *V. leavenworthii* var. *typica*	39	18	0
2. *V. ludoviciana* var. *typica* × *V. exigua* var. *exigua*	32	13	1
3. *V. leavenworthii* var. *typica* × *V. exigua* var. *exigua*	28	13	0
4. *V. leavenworthii* var. *occidentalis* × *V. ludoviciana* var. *typica*	3	1	0
5. *V. leavenworthii* var. *occidentalis* × *V. leavenworthii* var. *typica*	8	4	4
6. *V. leavenworthii* var. *occidentalis* × *V. exigua* var. *exigua*	7	3	0

stem tips for fixation of buds adversely affected the plants and they never recovered.

From these data, outcrossing in individual populations seems entirely possible inasmuch as intraspecific crosses were successful. Hybridization between taxa seems much less likely because crosses between different taxa produced few F_1 plants, and they were all abnormal. Even progeny from *V. leavenworthii* var. *occidentalis* × *V. leavenworthii* var. *typica* (cross 5, Table 2) were sterile, indicating that at least some barriers to interbreeding exist between these supposedly closely related taxa.

No apomixis was indicated.

Breeding system

Observations on the breeding system were made from living plants in the field and greenhouse. All taxa are very efficient selfers;

pollen usually is released within the young bud before the flower opens. In wet mounts of styles from young buds, germinating pollen grains were common.

Bagging did not reduce fruit set. When all buds but one were removed from the peduncle and that single flower bagged, fruit set still was successful. Shaking the plant did not alter fruit set; self-fertilization seemed effective almost to the point of cleistogamy.

In all my field work, no pollinators were observed on these vetches. Pollinators were seen in the immediate area, but clearly preferred other flowers. The only record of actual insect manipulation seems to be a herbarium sheet notation by Shinners, "Visited by honeybees" (*Shinners 9793,* ARIZ, SMU).

It seems reasonable to conclude that a small proportion of flowers probably reach anthesis with intact anthers and are at least potential outcrossers. However, because pollinators would be required for successful outcrossing, and pollinators seem infrequent, outcrossing must be rare.

Plitman (1967), in studying 50 annual *Vicia* species of the Middle East, concluded that self-pollination occurs in young buds precisely as just described. He stated that self-pollination, cleistogamy, and cross-pollination may occur in the same species, even the same individual, but suggested no actual method by which cross-pollination might occur in a predominantly self-pollinated taxon.

Allard and Workman (1963) and others have shown that, in populations of many different self-fertilized species, some outcrossing does occur. Allard et al. (1968) reviewed data supporting the hypothesis that most inbreeders contain large stores of genetic variability and that genetic and morphological variation within species and within populations can be considerable.

A different system evidently operates in *Vicia leavenworthii* var. *typica* and other traditional taxa in part (*V. ludoviciana* subsp. *leavenworthii* of the following taxonomic treatment). These populations were the most homogeneous of the complex. These plants have a short style, the anthers at dehiscence are all positioned above the stylar pubescence (Figure 2), and pollen is released directly onto the stigma. In other taxa with longer styles (which represent *V. ludoviciana* subsp. *ludoviciana* of the following taxonomic treatment), anthers at dehiscence are at the level of stylar pubescence (Figure 2), and pollen is released upon the stylar hairs. The stylar hairs are antrorse, and in the confines of the folded keel, pollen is

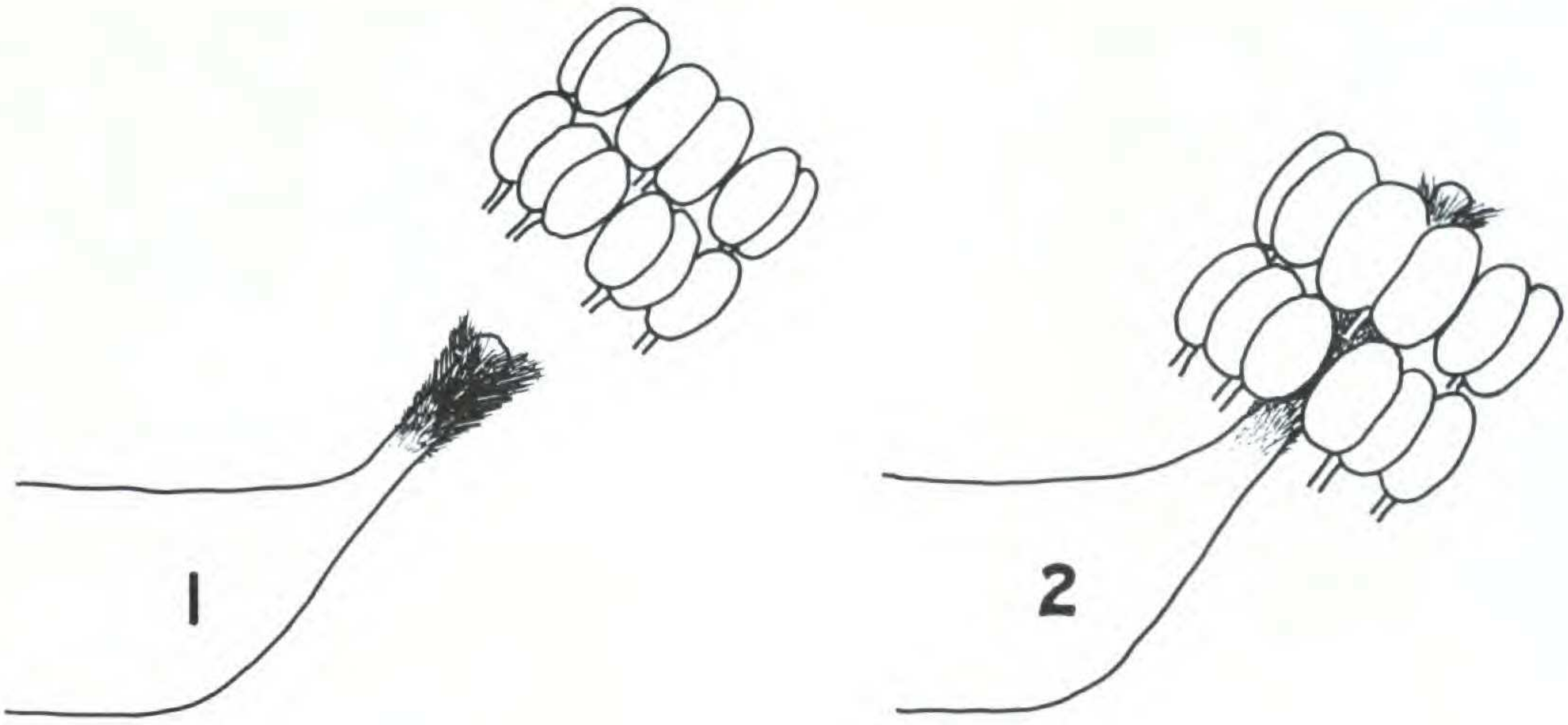


Figure 2. Anther positions of *Vicia*..
1. *V. ludoviciana* subsp. *leavenworthii* (of this taxonomic treatment, races 6 and 7).
2. *V. ludoviciana* subsp. *ludoviciana* (of this taxonomic treatment, races 1–5).

eventually worked apically to the pocket at the keel tip and effectively placed onto the stigma.

Anthers in *Vicia ludoviciana* subsp. *leavenworthii* are shorter (0.30–0.35 mm) than in subsp. *ludoviciana* (0.40–0.55 mm), this condition may reflect a more effective self-pollination system. In subsp. *leavenworthii,* anthers were always observed to dehisce well before flowers opened, and young fruits were most often already developing at anthesis. In addition, flowers open before peduncles and internodes elongate, and the flowers are inconspicuous among the leafy stem tips. Even if some flowers were potential outcrossers, they presumably would be inconspicuous to pollinators.

In *Vicia ludoviciana* subsp. *leavenworthii,* it seems that almost no flowers could be potential outcrossers, thus this taxon must be very highly self-pollinated.

TAXONOMIC TREATMENT

I am interpreting the *Vicia ludoviciana* complex as a single multiracial species because its elements are all confluent. An opposing position might be supported on the basis of karyotype differentiation and infraspecific incompatibility. I believe it better, however, to limit formal names to only two subspecies that can be relatively well defined. Several taxa which have previously been given formal species or varietal rank are recognized informally as geographical races.

The characters listed in the key and descriptions are those that have proved most useful in identification and recognition.

KEY TO SUBSPECIES AND RACES OF *VICIA LUDOVICIANA*

1. Flowers opening after peduncles and internodes elongate, pinkish-white to deep bluish-purple, young fruit usually not present when flowers first open; styles (0.60) 0.80–1.40 (1.70) mm long; leaflets (5) 7–10 (13) .... A: subsp. *ludoviciana* 2
  2. Style length (0.6) 0.8–1.2 (1.3) mm; calyx tube (1.1) 1.4–1.8 (2.2) mm long; stems at midpoint glabrous to pubescent 3
    3. Flowers 1–19, averaging 5–9; fruiting peduncles (0.4) 0.6–0.9 (1.3) mm wide; hilum/circumference ratio in percent (22.5) 29.0–37.4 (42.4); plants of eastern Texas, Louisiana, Arkansas, and southern Mississippi and extreme Southern Alabama .... subsp. *ludoviciana* race 1
    3. Flowers 1–10, averaging 1–3; fruiting peduncles (0.2) 0.3–0.6 (0.8) mm wide; hilum/circumference ratio in percent (11.2) 17.4–23.7 (31.8) 4
      4. Flowers usually 3 with one terminal flower and a contiguous pair below; plants of the Gulf Coastal and Rio Grande Plains of Texas .... subsp. *ludoviciana* race 2
      4. Flowers 1–3, each flower usually arising at a separate point on the peduncle; plants of California and Baja California .... subsp. *ludoviciana* race 3
  2. Style length (0.9) 1.1–1.4 (1.7) mm; calyx tube (1.3) 1.7–2.1 (2.5) mm long; stems at midpoint glabrous to densely pubescent 5
      5. Peduncles 1–5 flowered, (0.9) 8–35 (47) mm long when flowers are open, usually about 1/3 the length of the subtending leaf; hilum/circumference ratio in percent (7.9) 10.4–18.1 (20.7); plants of western Texas, the Oklahoma panhandle, Colorado, Utah, New Mexico, Arizona, extreme southern Nevada, and extreme southeastern California .... subsp. *ludoviciana* race 4
      5. Peduncles 1–17 flowered, (15) 21–41 (120) mm long when flowers are open, about as long or longer than the subtending leaf; hilum/circumference ratio in percent (16.7) 18.7–20.9 (24.3); plants of central Texas, southern Oklahoma, and southern New Mexico ..... subsp. *ludoviciana* race 5
1. Flowers opening before peduncles and internodes elongate, pinkish-white to light lavender, often containing young fruit when flowers first open; styles (0.40) 0.60–0.80 (0.90) mm long; leaflets (7) 11–15 (17) .... B: subsp. *leavenworthii* 6
  6. Flowers 1–6; legumes mostly less than 30 mm long; length of hilum less than the seed diameter; leaflets 2.5–7.0 times as long as wide; plants of central Texas, Oklahoma, extreme northwestern Arkansas, and extreme southwestern Missouri .... subsp. *leavenworthii* race 6

6. Flowers 1–2; legumes mostly 30 mm long or longer; length of the hilum greater than the seed diameter; leaflets 2.0–3.0 times as long as wide; plants of Louisiana, Oklahoma (McCurtain Co.), scattered sites in Arkansas, and Mississippi (Claiborne Co. and Sharkey Co.) . . . . subsp. *leavenworthii* race 7

A: **Vicia ludoviciana** Nutt. ex T. & G. subspecies **ludoviciana**

Vicia ludoviciana Nutt. ex T. & G. Fl. N. Amer. 1: 271. 1838. LECTOTYPE NY!: Dr. Leavenworth, Near Nagodoches (sic!) and Natchitoches [Louisiana].
Cracca ludoviciana (Nutt. ex T. & G.) Alefeld. Bonplandia 9: 119. 1861.
Vicia ludoviciana var. *typica* Shinners. Field Lab. 16: 23. 1948.

Vicia caroliniana var. *texana* T. & G. Fl. N. Amer. 1: 271. 1838. LECTOTYPE NY!: Leavenworth, Texas.
Vicia texana (T. & G.) Small Fl. Se. U.S. p. 656 1903.
Vicia ludoviciana var. *texana* (T. & G.) Shinners. Field Lab. 16: 23. 1948.

Vicia thurberi S. Wats. Proc. Am. Acad. Sci. 25: 129. 1890. LECTOTYPE GH!; ISOLECTOTYPES GH!, NY!: *Thurber 299*, Dona Ana [Co., New Mexico]. SYNTYPES GH!: *Thurber 150*. SYNTYPES GH !, US!: *Wright 1350*. SYNTYPE ISC!, NY!: *Parry 33*, 1874, S. Utah.

Vicia producta Rydb. Bull. Torr. Bot. Club 28: 500. 1901. LECTOTYPE NY!, ISOTYPE NY!: *P. A. Rydberg and F. K. Vreeland 6006*, Butte, 5 miles southwest of La Veta, Colorado, May 22, 1900.

Vicia ludoviciana var. *laxiflora* Shinners. Field Lab. 16: 25. 1948. HOLOTYPE SMU!, ISOTYPE MO!: *Eula Whitehouse 15275*, April 13, 1946. About 3 miles north of Bridgeport on Highway 24, Wise County, Texas.

Vicia leavenworthii var. *occidentalis* Shinners. Field Lab. 16: 22. 1948. HOLOTYPE SMU! ISOTYPE MO! NY!: *C. H. Muller*, Chisos Mts., Boot Spring. July 29, 1932.

Vicia exigua Nutt. ex T. & G. Fl. N. AM. 1: 272. 1838. HOLOTYPE BM (photograph!). ISOTYPE PH!: *Nuttall*, Columbia Plains (see discussion below).
Cracca exigua (Nutt. ex T. & G.) Alefeld, Bonplandia 9: 119. 1861.

DESCRIPTION. Plants diminutive to robust, 0.8–20.0 dm tall, glabrous to pubescent, erect to sprawling, or climbing if support is available. Leaflets (5) 7–10 (13), (6) 10–19 (37) mm long, (0.9) 1.6–3.8 (11) mm wide, the length–width ratio (2.0) 3.7–8.7 (16.4), the apex acute to emarginate. Flowers opening after peduncles and internodes elongate, the flowering peduncles (0.9) 6–30 (101) mm long, as long as to shorter than the subtending leaf, the subtending leaf (10) 24–46 (75) mm long. Fruiting peduncles (1.1) 21.7–59.7 (150) mm long, from shorter than to equaling and longer than the subtending leaf, the subtending leaf (18) 31–60 (96) mm long. Flowers 1–19, the standard varying from short, stubby and not showy to long, broad and showy, the height of the reflexed standard (0.64) 0.94–1.40 (1.65) times the flower length from the calyx base to the tip of wings, length of flower from calyx base to tip of unreflexed standard (3.5) 5.1–6.9 (9.5) mm. Upper calyx teeth (0.4) 0.7–1.2 (2.6) mm long, usually shorter than the lower tooth, the lower tooth (0.6) 1.1–1.7 (3.0) mm long and usually shorter than the calyx tube, the tube (1.1) 1.6–2.0 (2.5) mm long. Styles (0.60) 0.83–1.23 (1.70) mm long, the apical (0.30) 0.52–0.74 (1.10) mm pubescent. Mature legume (2.0) 17.8–23.2 (32) mm long. Ovules up to 8, seeds 3–9, the hilum-circumference ratio in percent (8) 18–33 (42).

NOMENCLATURAL HISTORY AND DISCUSSION OF TYPE SPECIMENS. *Vicia ludoviciana* was based on collections by Leavenworth and Tainturier. The Leavenworth collection contains two specimens, both of which are traditional *V. ludoviciana* (*V. ludoviciana* subsp. *ludoviciana* race 1 of this treatment). I follow Shinners (1948) in considering this collection as the type. The Tainturier (PH!) gathering consists of four stems on a sheet also containing an unrelated California collection by Gibbons. This collection is *V. ludoviciana* subsp. *leavenworthii*, cannot be considered a type for subspecies *ludoviciana*, and is discussed under subspecies *leavenworthii*.

Vicia thurberi was based on four different gatherings. Twelve of these specimens were seen, and all are *V. thurberi*. However, all the duplicates of each gathering do not match exactly in label information or collection sites and probably represent plants from different locations. I have chosen one specimen of *Thurber 299* at GH as the lectotype of *V. thurberi* because it is typical, contains both flowers and fruits, and the collection is distributed in two major herbaria. Other types are indicated in the synonomy.

Only a photograph of the holotype of *Vicia exigua* was available for this study. Howell, in preparation of the first edition of his Marin Flora (1949) saw the holotype and affixed the following note:

> From the type description of *Vicia exigua* Nutt. (T. & G., Fl. N. A. 1: 272) it is obvious Nuttall saw plants from California as well as from the Columbia. I believe that the two speciens on this sheet are from these two regions and that the California label has been lost. From the type description it is easy to determine that the lefthand specimen is the one from "the Oregon", the one on the right from "Upper California". 8/26/35.
> John Thomas Howell.

Lassetter (1975), with only a photograph of the BM sheet available, designated the righthand specimen as the lectotype. Since that time C. R. Gunn has examined the sheet, and after a personal conversation with him, I consider both specimens on the sheet to be *Vicia exigua;* now the entire sheet may be considered holotype material.

The remaining names reduced to synonomy under *Vicia ludoviciana* subsp. *ludoviciana* were each based on only one element, and no problems with interpretation of type specimens were encountered.

The three earliest specific epithets of the complex all date from 1838. *Vicia ludoviciana* was chosen for the species name because it has been associated with the plants of the widest geographical distribution. Also, little conceptual confusion should result by choosing *V. ludoviciana* because the typical subspecies will retain the epithet *ludoviciana,* and the kinds of plants traditionally associated with this name will not be altered.

Subsp. **ludoviciana** race 1

DESCRIPTION. Plants diminutive to robust, 1.0–20.0 dm tall, glabrous to puberulent, erect to sprawling, climbing if support is available. Leaflets (5) 8–11 (13), (6) 12–16 (25) mm long, (1.2) 2.5–4.7 (11) mm wide, the length/width ratio (2.0) 2.8–4.6 (8.5), the apex acute to truncate or emarginate. Flowering peduncles (6.0) 16.0–44.0 (101.0) mm long, usually about as long as or longer than the subtending leaf, the subtending leaf (15) 24–50 (75) mm long. Fruiting peduncles (9) 26–65 (112) mm long, usually about as long as or longer than the subtending leaf, the subtending leaf (18) 45–69 (97) mm long. Flowers 1–19, averaging 4–9, the flowers solitary or in pairs at points on the peduncle, deep blue or bluish purple, the standard broad and showy, the height of the reflexed standard (0.81) 0.94–1.12 (1.22) times the length of the flower from calyx base to tip of wings, the length of flowers from calyx base to tip of unreflexed standard (4.2) 5.0–6.5 (8.2) mm. Upper calyx teeth (0.5) 0.8–1.2 (1.5) mm long, usually shorter, but varying to as long as the lower tooth, the lower tooth (0.7) 1.2–1.8 (2.7) mm long, about as long as the calyx tube, the tube (1.1) 1.4–1.7 (2.1) mm long. Styles (0.70) 1.00–1.20 (1.30) mm long, the apical (0.30) 0.60–0.80 (1.00) mm pubescent. Mature legumes (16) 18–24 (28) mm long. Ovules up to 8. Seeds 4–8, usually about 5, the hilum/circumference ratio in percent (23) 29–38 (42).

Range and habitat. Eastern Texas, Arkansas, Louisiana, extreme southern Mississippi and Alabama. (Figure 3).

Dense woods and open woodland; thickets; grasslands and pastures; floodplains and low areas; railroad and highway rights-of-way; fence rows and field edges; weedy areas; shell ridges; wasteland; lawns and vacant lots.

Mostly in sandy soil, but also in loams, limestone, silty clay, clay.

Phenology. Flowering in (early February) March–early May (early July), fruiting in (late March) April–May (July).

Discussion. Taxa which compose race 1 are *Vicia ludoviciana* var. *ludoviciana* sensu Hermann (1960) in part, and sensu Turner (1959) in part, and *V. ludoviciana* var. *typica* sensu Shinners (1948) in part.

Race 1 plants from Texas are typically many-flowered (averaging 7 or more) and usually have 10 or fewer lanceolate to elliptic or oblong leaflets. This race has the middle-sized flowers of the complex, with other races averaging shorter or longer. Race 1 plants in Louisiana and eastward usually are more robust, typically fewer-flowered (averaging 6 or less), the flowers usually are short and stubby, and leaflets are mostly 10 or more and oblong to ovate.

The range of race 1 is essentially the eastern portion of the range of the entire complex; this race extends west only as far as eastern Texas (Figure 3). The southwestern limit of distribution of this phase corresponds closely with the northeastern edge of the Rio Grande Plain.

Race 1 is sympatric in part with races 5, 2, 6, and 7, and intergrades with all but race 6. In the western portion of its range, race 1 tends to have longer upper calyx teeth and a slightly higher flower-length/standard-height ratio and resembles race 5. In the southern and southeastern portion of its range, flowers are smaller and fewer, and plants intergrade with race 2. The lush fewer-flowered race 1 plants of Louisiana and eastward resemble race 7.

Subsp. **ludoviciana** race 2

Description. Plants diminutive to robust, 2.1–19.0 dm tall, often spindly, glabrous to puberulent, erect to sprawling, climbing if support is available. Leaflets (7) 8–10 (13), (9) 13–21 (36) mm long, (1.3) 2.2–4.1 (6.4) mm wide, the length/width ratio (2.4)

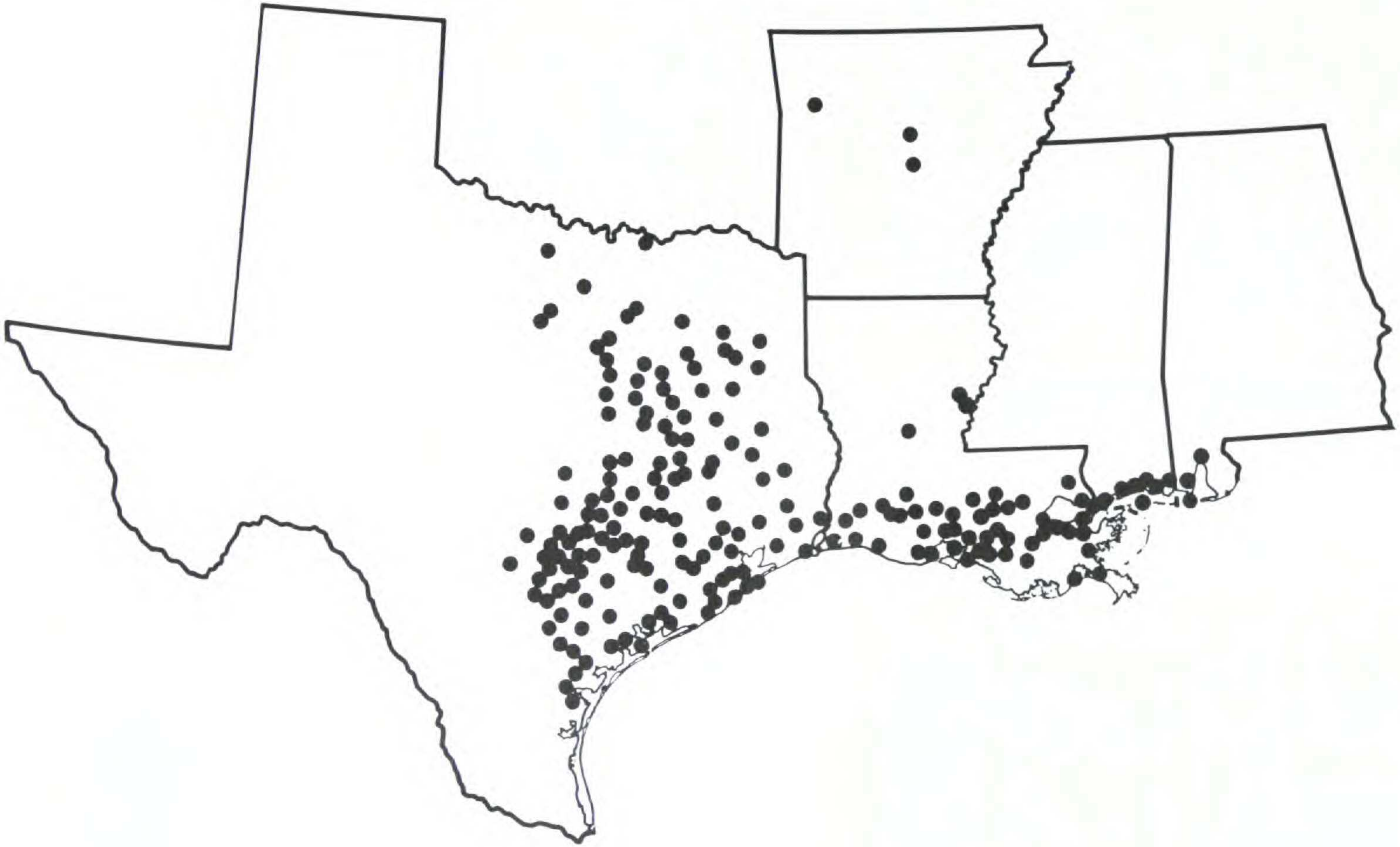


Figure 3. Distribution of *Vicia ludoviciana* subsp. *ludoviciana*, race 1.

3.8–7.6 (14.6), the apex acute to emarginate. Flowering peduncles (3.5) 11.0–29.0 (63.0) mm long, usually about 1/2 as long as to as long as the subtending leaf, the subtending leaf (12) 25–48 (64) mm long. Fruiting peduncles (4) 27–61 (106) mm long, about as long or longer than the subtending leaf, the subtending leaf (20) 31–53 (72) mm long. Flowers 1–10, usually 6 or less, often 2 with both flowers arising from the same point, and often 3 with 1 upper flower and 2 arising from a single point below, or flowers occurring singly at points on the peduncle, bluish to deep bluish-purple, the standard somewhat broad and showy, the height of the reflexed standard (1.00) 1.10–1.30 (1.39) times the flower length from the calyx base to tip of wings, the length of flowers from calyx base to tip of unreflexed standard (3.5) 4.5–5.8 (6.8) mm. Upper calyx teeth (0.4) 0.6–1.0 (1.5) mm long, usually shorter than the lower tooth, the lower tooth (0.6) 1.1–1.6 (2.1) mm long, usually shorter than the calyx tube, the tube (1.1) 1.4–1.8 (2.1) mm long. Styles (0.60) 0.80–1.10 (1.30) mm long, the apical (0.30) 0.45–0.65 (0.80) mm pubescent. Mature legumes (13) 16–22 (27) mm long. Ovules up to 8. Seeds 4–7, usually 6, but often fewer, the hilum/circumference ratio in percent (15) 18–24 (32).

RANGE AND HABITAT. The Rio Grande Plain and Gulf Coastal Plain of southern Texas (Figure 4).

Open woodland; riverbanks and creek beds; mudflats; prairies and fields; the Gulf shore; roadsides; wasteland; ditches.

In sand, sandy silt, sandy loam, sandy clay, calcareous clay, clay, silt, over limestone, rocky soil.

PHENOLOGY. Flowering in (late February) March–April (early May), fruiting in (late March) April–May.

DISCUSSION. Plants which are the most well-known members of race 2 are *Vicia ludoviciana* var. *texana* (Shinners, 1948; Hermann, 1960), but *V. leavenworthii* var. *occidentalis* sensu Turner (1959) in part is also included.

Typical three-flowered race 2 plants have one upper flower and two flowers arising from a common point below. On two-flowered peduncles, flowers may arise from the same point or from separate points. The stubby flowers, along with those of race 3, are the shortest of the complex.

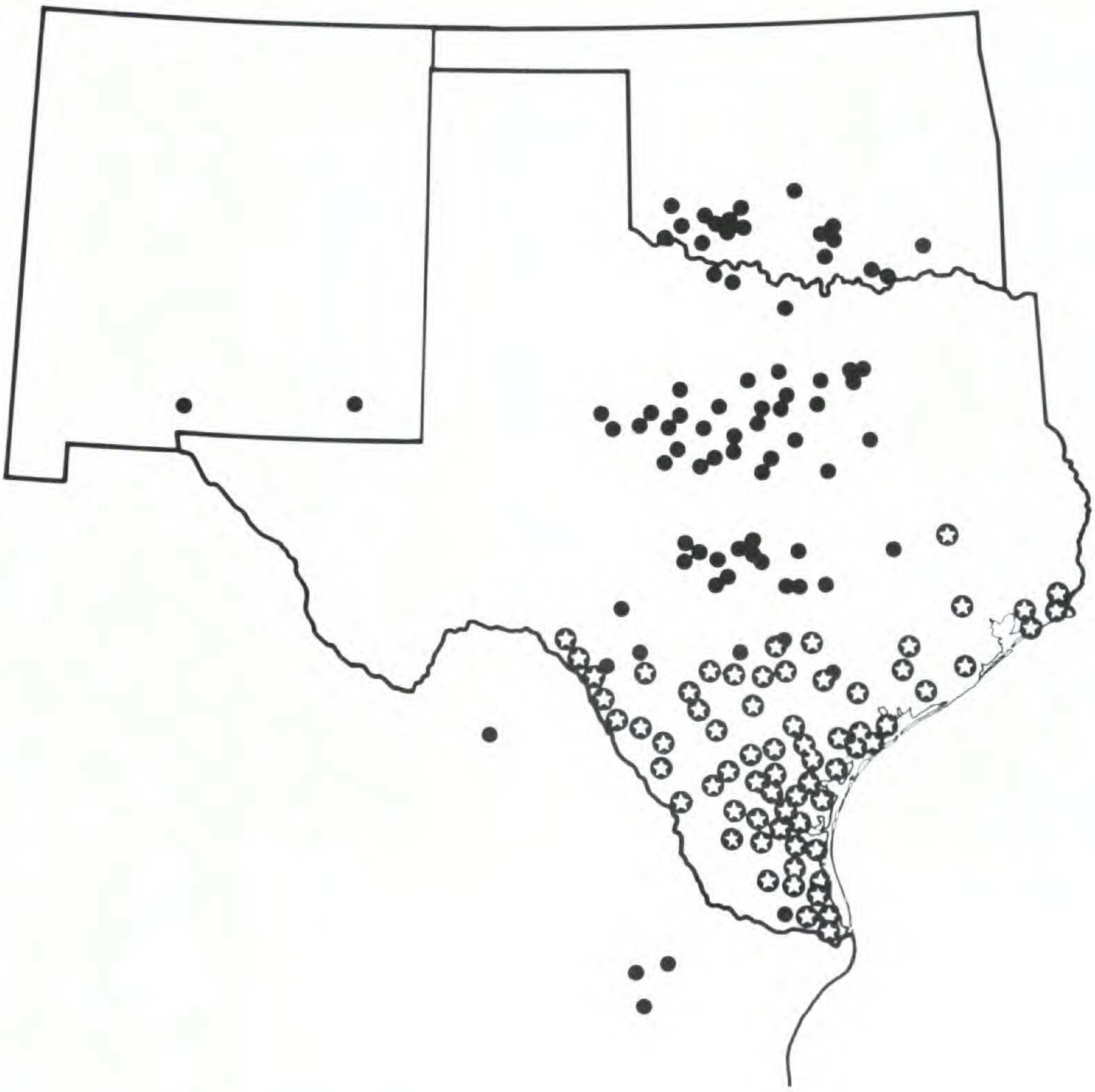


Figure 4. Distribution of *Vicia ludoviciana* subsp. *ludoviciana*, races 2 and 5. Stars = race 2, circles = race 5.

In southern Texas, the distributions of races 2, 4, 1, 5 and 6 overlap, and intergradation with race 2 occurs. As one progresses west up the Rio Grande Valley, race 2 steadily grades into race 4. Along the Gulf Coast, race 2 and 1 resemble each other. Race 2 also blends with race 6 in the Gulf Coast region. Although usually distinct from each other, race 2 (Figure 4) intergrades with the most southern race 5 forms.

Correll and Johnston (1970) stated that *Vicia ludoviciana* var. *texana* (my race 2) was particularly perplexing taxonomically. The distribution of race 2 in Texas is rather limited and, within much of that range, commonly overlaps and intergrades with other races.

Consequently, areas of intermediate race 2 probably outnumber areas of typical race 2. Typical race 2 populations are best found to the exclusion of intergrading forms in Kenedy, Willacy, and Cameron Counties.

Subsp. **ludoviciana** race 3

DESCRIPTION. Plants diminutive to robust, 1.6–11.0 dm tall, glabrous to pubescent, erect to sprawling, climbing if support is available. Leaflets (4) 6–9 (12), (9) 14–25 (37) mm long, (0.9) 1.6–3.4 (6.3) mm wide, the length/width ratio (3.6) 5.8–11.2 (16.4), the apex acute to truncate. Flowering peduncles (3.0) 10.0–32.0 (66.0) mm long, usually about 1/2 as long, but varying to as long as or much shorter than the length of the subtending leaf, the subtending leaf (18) 27–47 (65) mm long. Fruiting peduncles (3) 33–50 (71) mm long, from much shorter to as long as or longer than the subtending leaf, the subtending leaf (22) 32–57 (75) mm long. Flowers 1–3, rarely 4, occurring singly at points on the peduncles, or 2 flowers sometimes arising from the same point; bluish. The standard somewhat broad and showy, the height of the reflexed standard (0.91) 1.12–1.38 (1.47) times the flower length from the calyx base to tip of wings, the length of flowers from calyx base to tip of unreflexed standard (4.3) 4.4–6.5 (7.5) mm. Upper calyx teeth (0.6) 0.7–1.1 (1.4) mm long, usually slightly shorter than the lower tooth, the lower tooth (0.9) 1.1–1.5 (1.7) mm long, usually shorter than the calyx tube, the tube (1.3) 1.6–2.0 (2.2) mm long. Styles (0.70) 0.85–1.10 (1.20) mm long, the apical (0.30) 0.45–0.65 (0.70) mm pubescent. Mature legumes (15) 18–24 (26) mm long. Ovules up to 7. Seeds 3–7, usually 5 or 6, the hilum/circumference ratio in percent (11) 17–22 (27).

RANGE AND HABITAT. Southern California and Baja California, one distant collection from northern California seen (Figure 5).

Wooded areas; moist slopes, ravines, and canyons; foothills; along creeks; chapparal; beaches; dry wasteland.

Sand, rocky soil.

PHENOLOGY. Flowering in (February–March) April–May, fruiting in (February) April–May (June).

DISCUSSION. Race 3 is almost identical morphologically with race 2. However, geographical separation between the two races is

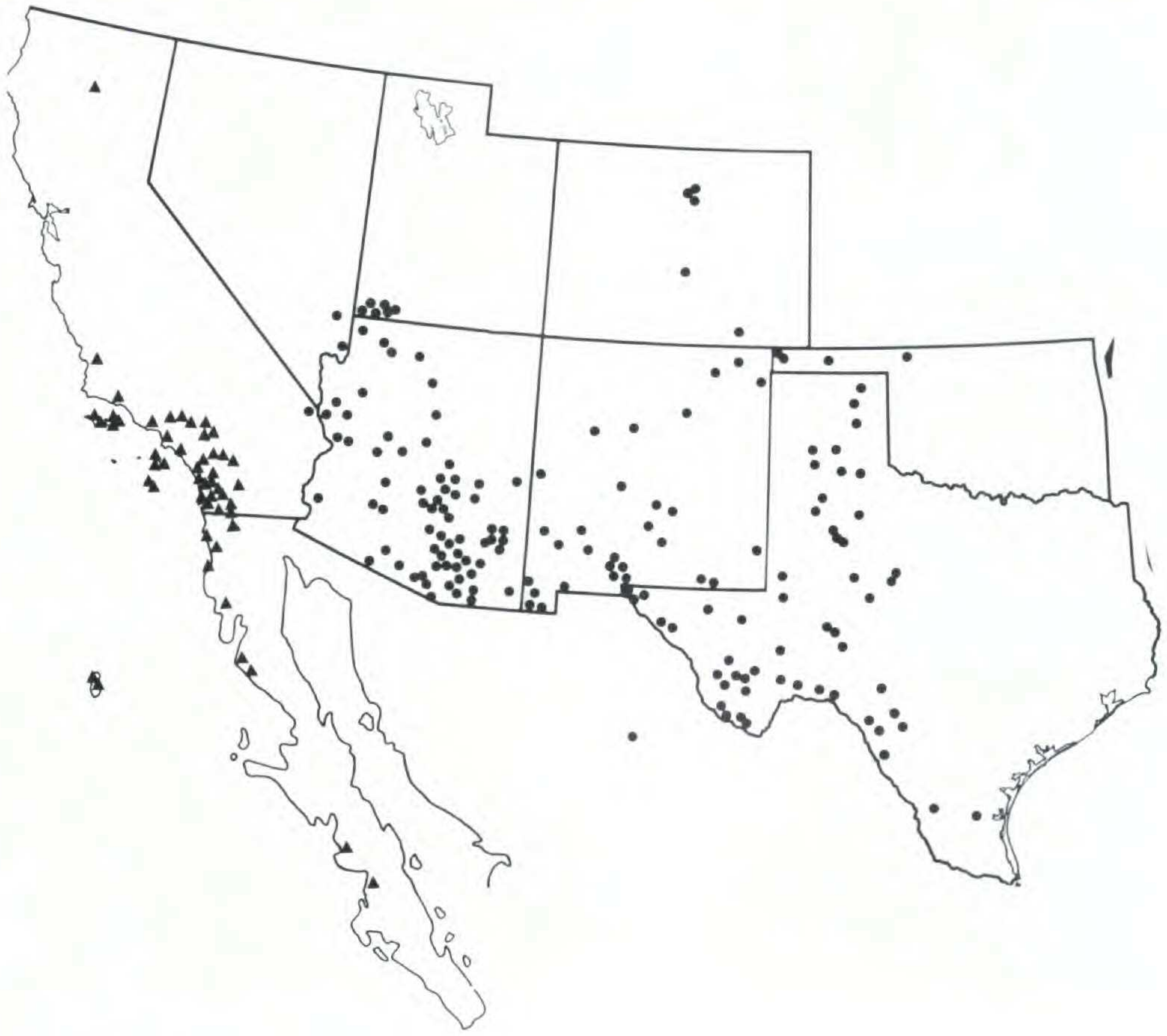


Figure 5. Distribution of *Vicia ludoviciana* subsp. *ludoviciana*, races 3 and 4. Triangles = race 3, circles = race 4.

great (Figures 4 and 5) and climatic conditions differ markedly between these two geographical areas. For these reasons, the two races are recognized separately.

Race 3 plants are west coast populations of The United States and Baja California and traditionally have been known as *Vicia exigua* var. *exigua* in part (see Lassetter, 1975) of various western authors, and *V. exigua* var. *exigua* sensu Hermann (1960) in part.

Typical race 3 plants have 1–3 flowers usually arising at separate points on the peduncle, but contiguous flowers are often found.

Race 3 is almost completely absent north of the Santa Barbara area (Figure 5), but is sympatric with *Vicia hassei* (Lassetter, 1975) in southern California. No intergradation between the two occurs. Race 3 and race 4 intergrade in the western portion of the range of the latter.

Subsp. **ludoviciana** race 4

Description. Plants diminutive to robust, 0.8–12.0 dm tall, glabrous to pubescent, erect to sprawling, climbing if support is available. Leaflets (5) 7–9 (11), (7) 10–17 (39) mm long, (1.0) 1.4–2.2 (4.2) mm wide, the length/width ratio (3.4) 5.9–9.7 (16), rarely up to 28 times as long as wide, the apex acute to truncate. Flowering peduncles usually short, (0.9) 4.0–11.0 (47.0) mm long, usually about 1/3 the length of the subtending leaf, the subtending leaf (10) 23–41 (60) mm long. Fruiting peduncles (1) 8–36 (47) mm long, about 1/2 or less the length of the subtending leaf, the subtending leaf (22) 28–67 (71) mm long. Flowers 1–5, averaging 1–3, usually only one flower occurring at any one point on the peduncle, pinkish-white to light lavender or bluish, the keel sometimes with a blue spot at apex, the standard not broad or showy, the height of the reflexed standard (.62) .67–.78 (1.02) times the flower length from calyx base to tip of wings, the flower length from calyx base to tip of unreflexed standard (4.8) 6.1–7.4 (8.4) mm. Upper calyx teeth (0.5) 0.7–1.0 (1.7) mm long, about subequal with the lower tooth, the lower tooth (0.9) 1.3–1.9 (2.2) mm long, slightly shorter than the calyx tube, the tube (1.4) 1.8–2.1 (2.4) mm long. Styles (0.90) 1.05–1.30 (1.70) mm long, the apical (0.40) 0.50–0.75 (0.85) mm pubescent. Mature legumes (20) 21–24 (26) mm long. Ovules up to 8 (rarely 9). Seeds 5–9, usually 7, the hilum/circumference ratio in percent (8) 11–18 (21).

Range and habitat. Western Texas and the Oklahoma panhandle, west and north to Colorado, Utah, New Mexico, Arizona, extreme southeastern Nevada, and extreme southeastern California (Figure 5).

Woodlands; rocky slopes and hillsides; canyons and dry washes; stream and creek beds; plains and grasslands; desert chaparral; roadsides; waste areas; fence rows; lawns; ditches.

In sand, limestone, gravel, calcareous clay loam, sandy loam, sandstone rubble, lava rock seams.

Phenology. Flowering in (late February) March–April (early May), fruiting in (late March) May–June (early August).

Discussion. Race 4 encompasses phenotypes which are best known traditionally as *Vicia producta.* Other taxa which are also included in race 4 are *V. thurberi* Watson, *V. exigua* var. *exigua* sensu Hermann (1960) in part, *V. leavenworthii* var. *occidentalis* sensu Shinners (1948), and *V. leavenworthii* var. *occidentalis* sensu Turner (1959) in part.

Typical plants have one to four flowers on peduncles which are rather short at fruiting. Individuals with short peduncles are typical in xeric microhabitats. More robust individuals with longer peduncles can be found throughout the range (Figure 5). Flowers usually occur singly at points on the peduncle, and the flower-length/standard-height ratios are rather low.

Race 4 is fairly well separated from other races throughout most of its range, but in southwestern Texas is sympatric with and intergrades into races 2, 5, and 6. Race 4 plants with long peduncles appear in the Chisos Mountains and continue southeast down the Rio Grande Valley where flowers progressively become contiguous; race 4 there intergrades into race 2. Going northeast from the Chisos and Davis Mountains, standards of race 4 become more showy and flowers more numerous as intergradation into race 5 occurs. A similar transition occurs in western Oklahoma. Some race 4 specimens blend into and closely resemble five- or six-flowered race 6 plants. Kinney County, Texas is an area where a great diversity of all these types of intergrading forms can be observed.

At the western edge of its range, race 4 intergrades with race 3. Calyx tube length of the two is about the same, and flowers are usually one or two per peduncle, but three-flowered plants in both races are not uncommon.

Subsp. **ludoviciana** race 5

DESCRIPTION. Plants diminutive to robust, 1.2–8.3 dm tall, glabrous to pubescent, erect to sprawling, climbing if support is available. Leaflets (6) 7–10 (13), (6) 9–17 (26) mm long, (0.9) 1.6–3.8 (8.0) mm wide, the length/width ratio (2.2) 4.5–7.5 (10.0), the apex acute to truncate or emarginate. Flowering peduncles (2.5) 30.0–60.0 (91.0) mm long, usually about as long as or longer than the subtending leaf, the subtending leaf (12) 28–62 (94) mm long. Fruiting peduncles (15) 34–96 (150) mm long, about as long or longer than the subtending leaf, the subtending leaf (21) 35–65 (82) mm long. Flowers 1–17, averaging 5–15, solitary or in pairs at points on the peduncle, mostly separated from each other when fruit is present, pinkish-white to deep lavender-purplish, occasionally white, the keel often with a blue spot at the apex, the standard broad and showy, the height of the reflexed standard (0.65) 0.69–1.06 (1.45) times the length of the flower from calyx base to tip of wings, the length of flowers from the calyx base to tip of unreflexed standard (5.3) 6.0–7.3 (9.5) mm. Upper calyx teeth (0.7) 1.1–1.6 (2.6) mm long, slightly shorter than the lower tooth, the lower tooth (1.2) 1.5–2.1 (3.0) mm long, about as long as to longer than the calyx tube, the tube (1.3) 1.6–2.0 (2.5) mm long. Styles (1.0) 1.2–1.4 (1.6) mm long, the apical (0.55) 0.60–0.80 (1.10) mm pubescent. Mature legumes (19) 20–25 (30) mm long. Ovules up to 8. Seeds 5–7, usually 6, hilum/circumference ratio in percent (14) 19–23 (29).

RANGE AND HABITAT. Central Texas and southern Oklahoma, plus two distant collections from southern New Mexico (Figure 4).

Open woods; river bottoms; rock seams and rocky slopes; prairies; railroad and highway rights-of-way; waste areas; lawns and vacant lots.

In granitic and limestone soils, serpentine and travertine, sand, sandy loam,silty clay, rocky limestone soil, fine gravel.

PHENOLOGY. Flowering in (late February) March–April (early May), fruiting in April–May.

DISCUSSION. Typical members of race 5 are characterized by large, showy standards and flower-length/standard-height ratios of (0.65) 0.69–1.06 (1.49), and are typified by *Vicia ludoviciana* var. *laxiflora* sensu Shinners (1948), Turner (1959), and Hermann (1960). Calyx teeth are typically relatively long and nearly subequal. The largest and showiest flowers of the entire complex are found in race 5 individuals from Llano County and a few other scattered locations in Texas, and from the mountainous areas of Oklahoma. Race 4 flowers are about the same length, but the standard is not as high as race 5, and therefore not as showy.

The major distribution of this race (Figure 4) appears to be three discrete areas with two distinct gaps in Texas. Although it is possible that the gaps reflect an artifact of incomplete collecting, I feel this explanation is not very probable since central Texas is a rather well-collected area. I have not been able to correlate the breaks in the distribution with geographical regions or with vegetation areas.

This race overlaps in range with and intergrades into races 1, 4, 6, and 2. In the eastern part of its range, race 5 intergrades into race 1, and in the western and southwestern part, a change to race 4 occurs. Few-flowered forms in central Texas often resemble race 6, and in southern Texas, few-flowered forms grade into race 2 and race 2–4 intermediates.

B. **Vicia ludoviciana** Nutt. ex T. & G. subspecies **leavenworthii** (T. & G.) Lassetter & Gunn (as stat. nov. in USDA Tech. Bull. No. 1601: 16. 1979.)

Vicia leavenworthii T.& G. Fl. N. Amer. 1: 271. 1838. HOLOTYPE NY!: Dr. Leavenworth. Arkansas.

Vicia leavenworthii var. *typica* Shinners. Field and Lab. 16: 22. 1948.

Cracca erotanthos Alefeld. Bonplandia 9: 118. 1861.

DESCRIPTION. Plants diminutive to robust, 1.0–12.0 dm or more tall, glabrous to pubescent, erect to sprawling, or climbing if support is available. Leaflets (7) 11–14 (17), (5) 10–23 (25) mm long, (1.2) 2.2–9.4 (11.0) mm wide, the length/width ratio (2.1) 2.2–5.0 (6.9), the apex acute to emarginate. Flowers opening before peduncles and internodes elongate, the flowering peduncles (0.8) 3.0–11.0 (28.0) mm long, usually much shorter than the subtending leaf, the subtending leaf (9) 20–65 (69) mm long. Fruiting peduncles (12) 26–70 (91) mm long, usually shorter than the subtending leaf, the subtending leaf (19) 30–92 (105) mm long. Flowers 1–6, pinkish white to light lavender, the standard not broad or showy, the height of the reflexed standard (0.57) 0.63–0.78 (1.04) times the flower length from calyx base to the tip of wings,length of flower from calyx base to tip of unreflexed standard (4.5) 5.1–6.8 (7.5) mm. Upper calyx teeth (0.5) 1.1–1.6 (2.0) mm long, shorter than to almost as long as the lowest tooth, the lowest tooth (1.0) 1.4–2.0 (2.2) mm long, and about as long as the calyx tube, the tube (1.3) 1.6–1.9 (2.2) mm long. Styles (0.40) 0.65–0.80 (0.90) mm long, the apical (0.20) 0.30–0.40 (50.0) mm pubescent. Mature legumes (18) 21–33 (35) mm long. Ovules up to 8, seeds 4–8, the hilum/circumference ratio in percent (15) 18–49 (55).

NOMENCLATURAL HISTORY AND DISCUSSION OF TYPE SPECIMENS. The holotype of *Vicia leavenworthii* is good, typical and traditional *V. leavenworthii*, and is a good example of race 6.

There is little doubt that *Cracca erotanthos* of Alefeld (1861) is the same as race 7 of this study. Alefeld stated that he obtained specimens from a Dr. Hexamer in New York and that Hale had collected the plant in Louisiana. There is an 1840 collection by Hale at NY. This sheet bears no locality designation but is race 7, which is centered in Louisiana. While it is possible (or probable) this represents the gathering seen by Alefeld, evidence and necessity scarcely warrant designating it a lectotype.

Alefeld specifically mentioned the fact that *Cracca erotanthos* does not fit the description of *Vicia ludoviciana* (Nutt. ex T. & G., 1838), and that it should not be confused with *V. ludoviciana,* as *Cracca erotanthos* possesses a long hilum. The hilum/circumference ratio of race 7 is by far the largest of the complex (Lassetter, 1978a).

The specimen at PH gathered by Tainturier from Louisiana, which was mentioned earlier, has been considered a type of *Vicia ludoviciana.* This is race 7 of this study [*V. ludoviciana* Nutt. ex T. & G. subsp. *leavenworthii* (T. & G.) Lassetter and Gunn], and should not be thought to be representative of the typical subspecies. It is typical race 7 of subsp. *leavenworthii.*

Subsp. **leavenworthii** race 6

DESCRIPTION. Plants diminutive to robust, 1.0–10.0 dm tall. Leaflets (7) 11–14 (17), (5) 10–15 (20) mm long, (1.2) 2.2–4.1 (6.3) mm wide, the length/width ratio (2.5) 3.4–5.0 (6.9), the apex acute to retuse. Flowering peduncles (0.8) 3.0–11.0 (28.0) mm long, usually much shorter than the subtending leaf, the subtending leaf, (9) 20–41 (57) mm long. Fruiting peduncles (12) 26–56 (91) mm long, slightly shorter than to longer than the subtending leaf, the subtending leaf (19) 30–50 (63) mm long. Flowers 1–6, averaging 2–4, most often one upper flower and 2 or 3 flowers arising from a common point below, or when 2 flowered, the 2 flowers arising from the same point. Upper calyx teeth (0.5) 1.1–1.6 (2.0) mm long, almost as long as the lower tooth, the lower tooth (1.0) 1.4–1.8 (2.1) mm long, about as long as the calyx tube. Mature legumes (18) 21–24 (29) mm long, the seed hilum/circumference ratio in percent (15) 18–22 (27).

RANGE AND HABITAT. Central Texas, Oklahoma, extreme northwestern Arkansas, extreme southwestern Missouri. (Figure 6)

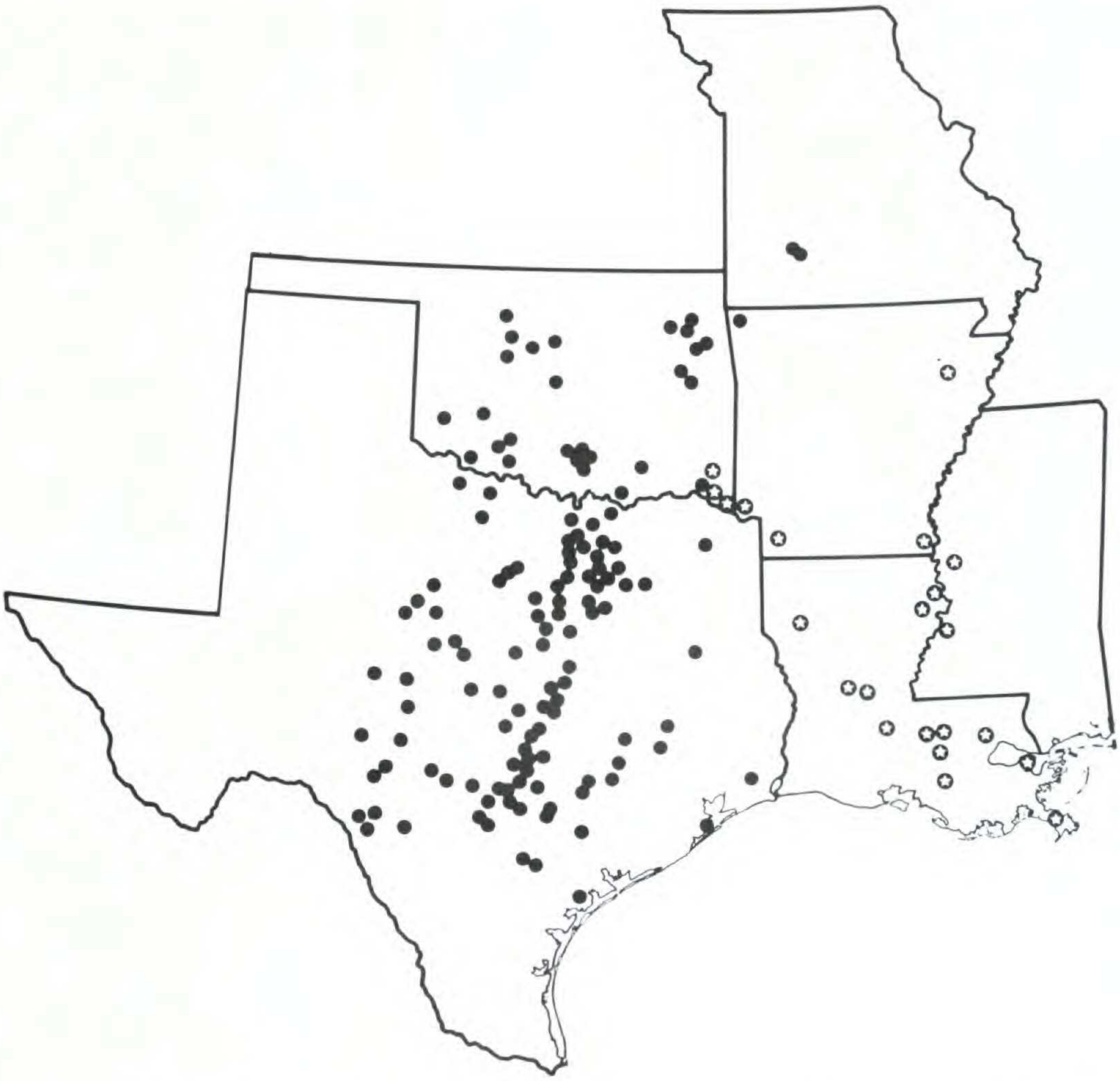


Figure 6. Distribution of *Vicia ludoviciana* subsp. *leavenworthii*, races 6 and 7. Circles = race 6, stars = race 7.

Open woods; wooded hills; limestone hills; cedar brakes; pastures; creek banks, river banks, stream beds, and flood plains; prairies; railroad and highway rights-of-way; waste ground; vacant lots and lawns.

PHENOLOGY. Flowering in April–early May, fruiting in April–May.

DISCUSSION. Excluding race 7, this race is the easiest to recognize, in spite of intergradation with several others. Typical race 6 usually has three or four pale flowers (one upper flower and two or three flowers from a common point below), very short styles, and numerous leaflets. Traditional taxa included in race 6 are *Vicia* *leavenworthii* var. *typica* (Shinners, 1948), *V. leavenworthii* var. *leavenworthii* (Turner, 1959), and *V. leavenworthii* (Hermann, 1960).

Race 6 is centered in Texas in the Blackland Prairie (Figure 6) as previous authors have stated. It also occurs on the Edwards Plateau, but is absent from an area known as the Central Basin or Central Texas Granite. Race 5, however, is prevalent on these soils which are derived from granitic parent material. Race 6 plants are most often found on clay loam soils with moderate amounts of calcium (Lassetter, 1978b).

Race 6 blends into race 2 on the Gulf Coast, into race 4 in western and southwestern Texas, and into race 5 in central Texas. It shares many characteristics with race 7, but because the two are sympatric only in McCurtain Co., Oklahoma, confusion should be minimal.

Subsp. **leavenworthii** race 7

DESCRIPTION. Plants usually robust, 3.0–12.0 dm or more tall. Leaflets (10) 11–13 (14), (13) 15–23 (25) mm long, (4.5) 5.8–9.4 (11.0) mm wide, the length/width ratio (2.1) 2.2–2.8 (3.1), the apex acute to emarginate, usually rounded or retuse. Flowering peduncles (3.0) 3.0–9.0 (12.0) mm long, much shorter than the subtending leaf, the subtending leaf (20) 23–65 (69) mm long. Fruiting peduncles (28) 30–70 (85) mm long, usually shorter than the subtending leaf, the subtending leaf (63) 63–92 (105) mm long. Flowers 1–2, from the same point or separate points on the peduncle. Upper calyx teeth (1.1) 1.2–1.4 (1.7) mm long, shorter than the lower tooth, the lower tooth (1.5) 1.8–2.0 (2.2) mm long, about as long as the calyx tube. Mature legumes (29) 29–33 (35) mm long, seed hilum/circumference ratio in percent (37) 41–49 (55).

RANGE AND HABITAT. Louisiana, McCurtain County, Oklahoma, scattered sites in Arkansas and Mississippi (Figure 6).

Deciduous woods and bottomland forests; along wooded streams; prairies and glades; fields; roadsides; levee banks.

Mostly in heavy (clay) soils, but also in sandy soils.

PHENOLOGY. Flowering in (late February) March–April (late May), fruiting in late March–May.

DISCUSSION. Race 7 is the most distinctive. Most plants are very robust, have large ovate leaflets, only one or two flowers per peduncle, large legumes, and the greatest hilum/circumference percentage. Plants included in race 7 have traditionally been recognized as *Vicia ludoviciana,* not *V. leavenworthii.* This race includes *V. ludoviciana* var. *typica* (Shinners, 1948, in part), and *V. ludoviciana* var. *ludoviciana* (Turner, 1959; Hermann, 1960) in part.

The distribution appears to be very limited (Figure 6); however, more complete collecting in the northern Louisiana area would be desirable in establishing the distribution more precisely. One 19th century collection from Florida (no specific location) was seen, but no recent material from that state was obtained.

Hermann's (1960) distribution map of *Vicia ludoviciana* var. *ludoviciana* contains a dot in east-central Mississippi. I presume this is based on *S. M. Tracy 1627,* Starkville, Mississippi (MISSA, US). Labels of several duplicates of this collection are marked "cultivated", and one sheet, US #67561, bears the caption "Native of Louisiana". This collection is race 7, and represents an introduction outside its natural range.

The other Mississippi sites are thought to be natural sites.

The few-flowered, robust forms of race 1 found in Louisiana and Mississippi resemble race 7, but no major problem should exist in distinguishing between the two. The relationship with race 6 is previously mentioned, and both races 6 and 7 (subsp. *leavenworthii*) can easily be separated from the 5 races of subsp. *ludoviciana,* because in subsp. *leavenworthii* the flowers open before the peduncles elongate.

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